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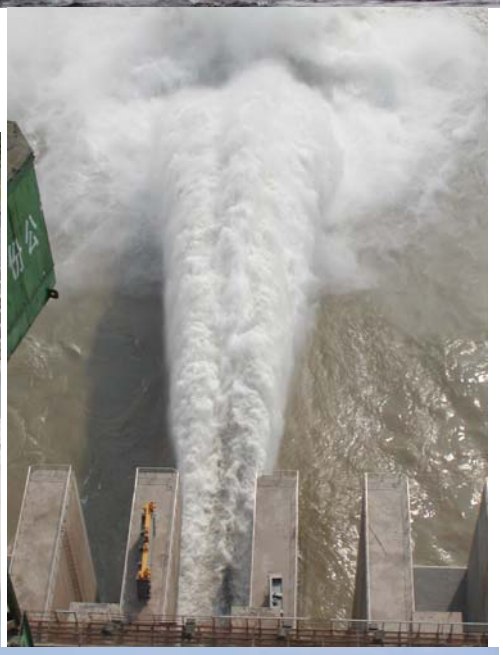
ENERGY DISSIPATION IN HYDRAULIC STRUCTURES



From top to bottom: Barrage Mercier (Canada) and spillway operation on 14 July 2002; Hinze dam spillway Stage 3 (Australia) in operation on 29 January 2013; Three Gorges Project (China) on 20 October 2004; Jiji weir stilling basin (Taiwan) on 11 January 2014

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Energy dissipation in hydraulic structures

Editor: Hubert CHANSON

Summary

Recent advances in technology have permitted the construction of large dams, reservoirs and channels. These progresses have necessitated the development of new design and construction techniques, particularly with the provision of adequate flood release facilities. Chutes and spillways are designed to spill large water discharges over a hydraulic structure (e.g. dam, weir) without major damage to the structure itself and to its environment. At the hydraulic structure, the flood waters rush as an open channel flow or free-falling jet, and it is essential to dissipate a very significant part of the flow kinetic energy to avoid damage to the hydraulic structure and its surroundings. Energy dissipation may be achieved by a wide range of design techniques. A number of modern developments demonstrated that energy dissipation may dissipated (a) along the chute, (b) in a downstream energy dissipator, or (c) a combination of both.

The magnitude of turbulent energy that must be dissipated in hydraulic structures is enormous even in small rural and urban structures. Let us consider a small storm waterway discharging 4 m^3/s at a 3 m high drop. The turbulent kinetic energy flux per unit time is 120 kW! At a large dam, the rate of energy dissipation can exceed tens to hundreds of gigawatts, that is many times the energy production rate of nuclear power plants. Many engineers have never been exposed to the complexity of energy dissipator designs, to the physical processes taking place and to the structural challenges. Several energy dissipators, spillways and storm waterways failed because of poor engineering design. It is believed that a major issue was the lack of understanding of the basic turbulent dissipation processes and of the interactions between free-surface aeration and flow turbulence.

In that context, a solid reference book on energy dissipation in hydraulic structures is proposed. The book contents encompass a range of design techniques including block ramps, stepped spillways, hydraulic jump stilling basins, ski jumps and impact dissipators.

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